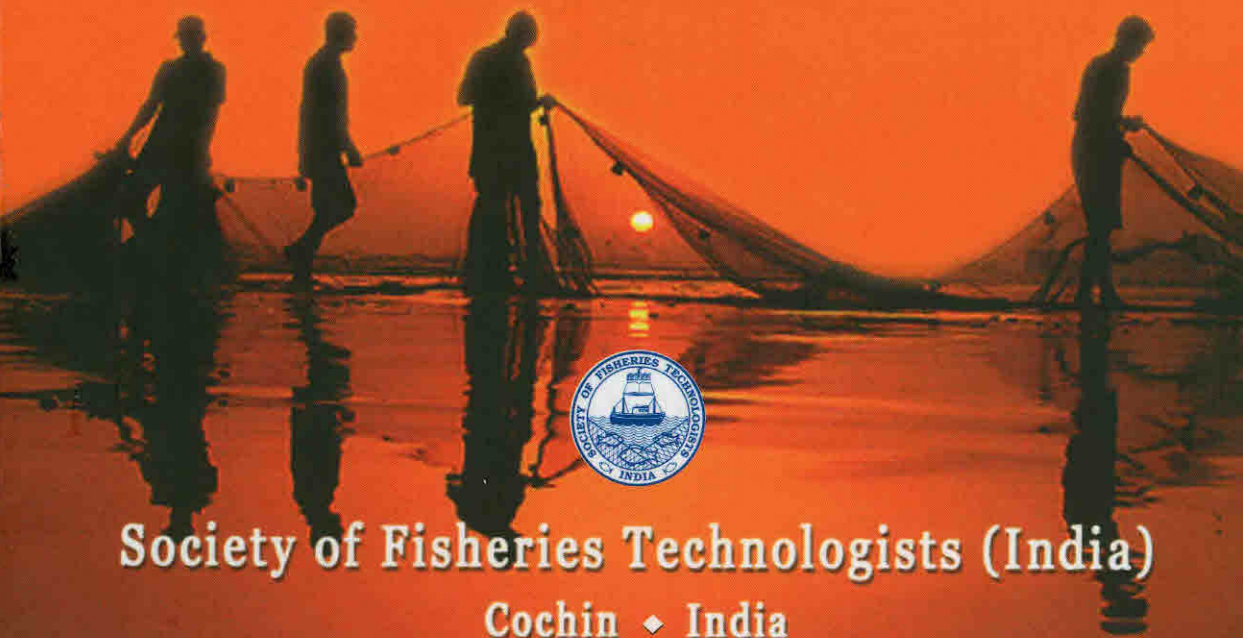


Coastal Fishery Resources of India

• Conservation and Sustainable Utilisation



Society of Fisheries Technologists (India)

Cochin ♦ India

Coastal Fishery Resources of India: Conservation and Sustainable Utilisation

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Heavy Metals in the Sediments from Mumbai Coast

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Introduction

Heavy metals, once thought to be insignificant as pollutants, has become one of the worst pollutants, following the outbreak of Minamata disease in Japan, as a result of Hg poisoning. Since then, various studies have been conducted on the effects of various heavy metals on the ecosystem. These research works led to the categorization of heavy metals as "black listed" and "grey listed" elements, and strict standards were laid down for the discharge of the same in the ecosystem (Phillips and Rainbow, 1997). Marine sediments can be a sensitive indicator for monitoring contaminants in the marine environment (Larsen and Jensen, 1989). Mumbai is a large metropolis on the west coast of India and forms the hub of important industrial activities. All the effluents generated in the city reaches the coastal waters. Studies on different aspects of heavy metal pollution on Mumbai coast have been conducted by several workers (Matkar *et al.*, 1981; Patel *et al.*, 1985; Gajbhiye, *et al.* 1985; Patel and Chandy, 1988; Qasim, *et al.* 1988; Kumari *et al.*, 1992; Nair and Kumari, 1993). However, information on current status of pollution would be useful in the coastal regions like Mumbai, which are under tremendous population and industrial pressure. The present study was carried out to understand the spatial and temporal variations of heavy metals such as Cu, Zn, Pb, Fe and Mn in the sediments of Mumbai coast.

Materials and methods

The status of pollution at Mumbai coast due to heavy metals (Cu, Zn, Pb, Fe and Mn) was assessed in sediment samples, collected for a period of 13 months from January 2000 to January 2001 from four selected stations in Mumbai coast. Station I and II were located on the beaches,

while station III was located on a creek and Station IV was a site near a fishing village (Fig. 1). The sediment in stations I and II was sandy, while Station III had clayey soil and at Station IV, it was clayey-loam. Sediment samples were collected during low tide and placed in polyethylene bags and transferred to the laboratory in ice. Sediment samples were processed and analyzed as per the procedure of Tam and Yao (1999), and analyzed in a flame atomic absorption spectrophotometer (ECIL 4129, India). The results were presented in mg.g^{-1} , on dry weight basis.



Fig. 1. Location of sampling stations at Mumbai Coast

Results and Discussion

The mean of heavy metals in the four stations under investigation in the present study were in the range of 19 -125 mg.g^{-1} for Cu; 30 - 145 mg.g^{-1} for Zn; 35 -71 mg.g^{-1} for Pb; 2565 -5590 mg.g^{-1} for Fe and 513-645 mg.g^{-1} for Mn, on dry weight basis (Table 1). The spatial and temporal variations of these metals in the four stations are given in Fig. 2. All the stations show an increase in concentration of Fe during the onset of monsoon and except station III no other stations showed any increment after June-July, for Fe. However, concentrations of Mn in all the stations showed an increase during the post-monsoon period

(September-October). Cu, Zn and Pb also showed similar increases during post-monsoon. The significant increase in metal concentrations during post-monsoon might be due to land run-off and the influx of metal-rich fresh water. Similar rise in heavy metals has been observed in Tuticorin Coast (Aanand, 1998), Pondichery harbour (Senthilnathan and Balasubramanian, 1999) and Karnataka Coast (Krishnakumar *et al.*, 1998). Levels of metals were found to differ significantly ($P < 0.05$) only between the stations. No significant difference was recorded between the months of sampling at all stations. A similar lack of significant difference in monthly metal concentrations has been reported in Karnataka coast (Krishnakumar *et al.*, 1998).

Table 1. Comparison of heavy metals (mg.g^{-1} ; dry weight basis) in sediments in the present study with earlier reports.

Area	Zn	Cu	Pb	Mn	Fe	Reference
Mumbai harbour, India	254	83	24	-	82-91	Patel, <i>et al.</i> (1985)
Mumbai harbour bay, India	180	-	-	95	-	Matkar <i>et al.</i> (1981)
Tuticorin coast, India	57-72	21-14	25-39	279-95	-	Aanand (1998)
Mangalore, India	68.8	37.0	6	-	-	Krishnakumar <i>et al.</i> (1998)
Karwar, India	2	24	4	-	-	Krishnakumar <i>et al.</i> (1998)
Kakinada bay, India	-	-	58-288	-	-	Sarma <i>et al.</i> (1996)
Chennai, India	82	164	-	244	11	Pragatheeswaran <i>et al.</i> (1986)
Visakapattanam, India	62	30	-	232	37	
Narbada estuary, India	140	136	-	1077	9	Borole <i>et al.</i> (1982)
Gulf of Mannar, India	15-31	8-20	-	46-128	1152-5756	Kumaresan <i>et al.</i> (1998)
Baja California, Mexico (Coastal sediments)	72-2750	46-1950	12-220	-	-	Vevey <i>et al.</i> (1993)
Baja California, Mexico (Beach sands)	3141-26970	3100-30380	460-2100	-	-	Vevey <i>et al.</i> (1993)
Lake Yoja, Honduras	122-3407	23-500	42-4495	-	-	Gil <i>et al.</i> (1988)
Hayle estuary, Hong Kong	900	570	200	768	35520	Shumlin <i>et al.</i> (2000)
Mumbai coast, India	31-146	19-126	35-71	514-645	2566-5591	Present study

In the present study, Fe, Cu, Pb and Zn were found to be highest in Station-III and Mn was found to be at its highest in Station-IV. Pb and Cu have been reported to be mostly of anthropogenic origin as the main source in the marine environment (Sadiq, 1992). Station-III, a creek had considerable levels of these heavy metals, *viz.* 5590.69 ± 182.31 mg Fe; 125.55 ± 19.95 mg Cu; 71.35 ± 34.12 mg Pb and 145.77 ± 42.56 mg Zn per gramme dry weight of sediment, probably due to the industrial effluents being discharged into the creek. Industrial discharges, shipping activities

Heavy Metals in the Sediments off Mumbai Coast

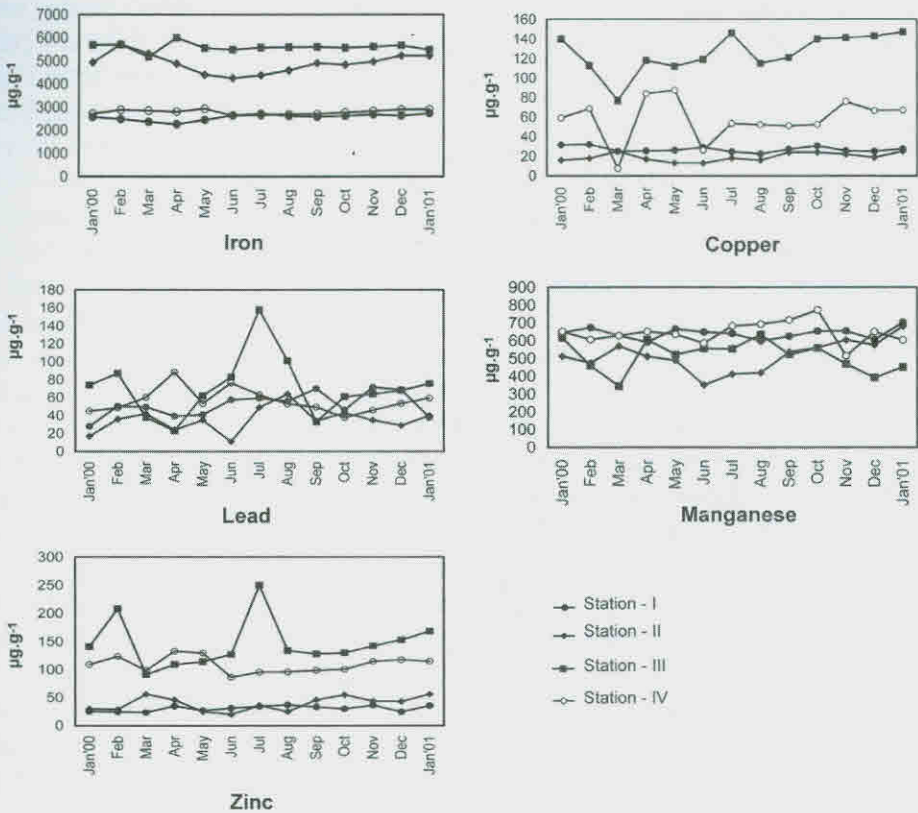


Fig. 2. Station-wise monthly variation in Fe, Cu, Pb, Mn and Zn

and sewage wastes have been found responsible for the heavy metal pollution of Vishakapatnam Harbour (Sarma *et al.*, 1996). In Madras, industrial effluents such as metallurgical, textile, organo-mercurial chemicals and sewage discharge have been attributed as the main sources (Pragatheeswaran *et al.*, 1986). Stations I and II are recreational beaches and lower levels of heavy metal pollution were detected at these sites, when compared to stations III and IV. This was in accordance with the general principle that larger the grain size less will be the levels of heavy metals. A preferential accumulation of Zn and Fe in finer fractions of sediments, and Cu and Mn in coarser fractions has been observed in Bombay harbour bay (Matkar *et al.*, 1981). This could explain the higher level of Mn in Station-IV than in Station-III, which has coarser sediment than the latter. The higher levels of Cu in Station-III might be due to the co-precipitation of Cu with Fe, as this station recorded the highest concentration of Fe content.

The levels of heavy metals detected in the present study were compared with the levels recorded by other workers from different parts of India (Table 1). The values for Mn were considerably higher than those reported earlier in Mumbai Harbour Bay (Matkar *et al.*, 1981). But, these levels were found within the range reported at Narbada estuary (Borole *et al.*, 1982). The levels of Fe, Zn, Cu, and Mn were higher than those reported at the Gulf of Mannar (Kumaresan *et al.*, 1998). However, all these metals were found to be well below the levels reported at Vishakapatnam and Chennai (Pragatheeswaran *et al.* 1986) as well as those in Narbada Estuary (Borole *et al.* 1982) and Mumbai Harbour Bay (Patel *et al.* 1985). The value of Cu recorded in the present study was considerably higher than that reported earlier from Mangalore and Karwar (Krishnakumar *et al.*, 1998). Station-III recorded the highest concentrations of all metals except Mn in the present study. In the case of Zn, stations I and II had values lower than those reported earlier. Pb showed higher values in all the four stations when compared to earlier reports. Therefore, further monitoring is required to study the source of increasing levels of Pb and Zn. The lower levels of the metals in the study at stations I and II might be due to less land drainage. All the metals recorded in the present study were, however, well below the contamination levels reported from other parts of the world such as the peninsula of Baja California, Mexico (Shumilin *et al.* 2000); Lake Youa, Honduras (Vevey *et al.*, 1993); Bahia San Antonio, Argentina (Gil *et al.* 1988) and Hayle Estuary, Hong Kong (Yim, 1976).

Conclusion

Concentrations of Fe, Pb, Mn and Cu obtained during the present observations were higher than the levels reported earlier from Mumbai harbour, while that of Zn was lower. The estimated metal concentrations were in the order of Fe>Mn>Zn>Cu>Pb and their levels showed significant difference among the stations.

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